



# Central Line-Associated Infections (CLABSI) in Non-Intensive Care Unit (non-ICU) Settings Toolkit

## Activity C: ELC Prevention Collaboratives

Alex Kallen, MD, MPH and Priti Patel, MD, MPH

Division of Healthcare Quality Promotion

Centers for Disease Control and Prevention

Draft - 1/22111/09 --- Disclaimer: The findings and conclusions in this presentation are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.



# Outline



- **Background**
  - Impact
  - HHS Prevention Targets
  - Pathogenesis
  - Epidemiology
- **Prevention Strategies**
  - Core
  - Supplemental
- **Measurement**
  - Process
  - Outcome
- **Tools for Implementation/Resources/References**



# Background: Impact



- Bloodstream infections (BSIs) are a major cause of healthcare-associated morbidity and mortality
  - Up to 35% attributable mortality
  - BSI leads to excess hospital length of stay of 24 days
- Central Line (CL) use a major risk factor for BSI
- More than 250,000 central line-associated BSIs (CLABSIs) in US yearly
- Rates of CLABSI appear to vary by type of catheter

Pittet et al. JAMA 1994; 271 1598-1601.

Klevens et al. Public Health Reports 2007;122:160-6.



## Background: HHS Prevention Targets



- Prevention of CLABSIs in Intensive Care Units (ICUs) and “other locations” have 2 associated goals in HHS HAI Prevention Plan:
  - Reduce CLABSIs to below NHSN 25<sup>th</sup> percentile by location type
  - 100% adherence with CL insertion practices in non-emergent situations



## Background: Impact Outside the ICU



- Most work aimed at reducing CLABSIs in the hospital has been done in ICUs
- Many CLs are found outside ICUs
  - In one study 55% of ICU patients had CL; 24% of non-ICU patients had CL
  - However, as more patients are located outside of the ICU, 70% of patients with CLs in the hospital were outside the ICU

Climo et al. ICHE 2003; 24:942-5.



## Background: Impact CLABSI Rates



- CLABSI rates outside ICUs may be similar to rates of these infections in ICUs
- Although data are sparse, in one study CLABSI rates were:
  - 5.7 per 1,000 catheter-days in 4 inpatient wards
  - 5.2 per 1,000 catheter-days for medical ICU

Marschall et al. Infect Control Hospital Epidemiol 2007;28:905-9.



# Background: Impact National Healthcare Safety Network (NHSN) CLABSI Rates



- From 2006 – 2008 NHSN report, pooled mean CLABSI rates were:
  - Medical-Surgical ICUs = 1.5 to 2.1 per 1,000 catheter-days
  - Medical-Surgical wards = 1.2 per 1,000 catheter-days

Edwards JR, et al. Am J Infect Control 2009;37:783-805.

<http://www.cdc.gov/nhsn/PDFs/dataStat/2009NHSNReport.PDF>



## Background: Impact CLABSI in Outpatient Settings

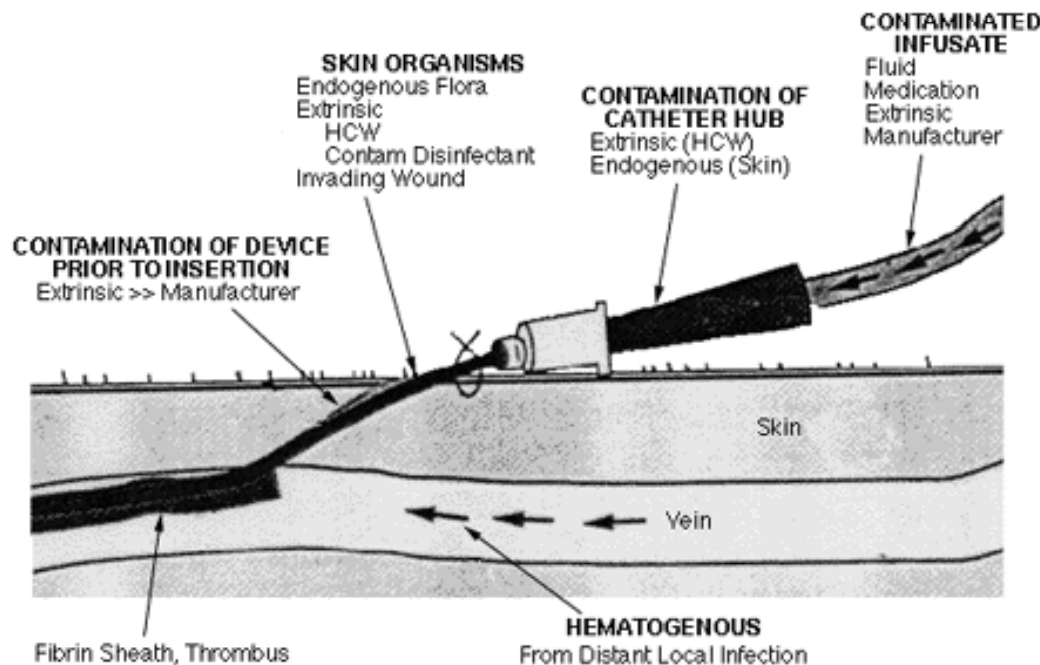


- A number of patient groups may have long-term CLs as outpatients
  - Hemodialysis
  - Malignancy
  - Gastrointestinal tract disorders
  - Pulmonary hypertension
- Rates of CLABSI may be as high as that seen in ICUs
  - In hemodialysis - 1 to 4 per 1,000 catheter-days





# Background: Pathogenesis CLABSI



## More Common Mechanisms

1. Pathogen migration along external surface
  - more common early (< 7days)
2. Hub contamination with intraluminal colonization
  - more common >10 days

## Less Common Mechanisms

1. Hematogenous seeding from another source
2. Contaminated infusates

Canada Communicable Disease Report - *Supplement*  
Volume: 23S8, December 1997

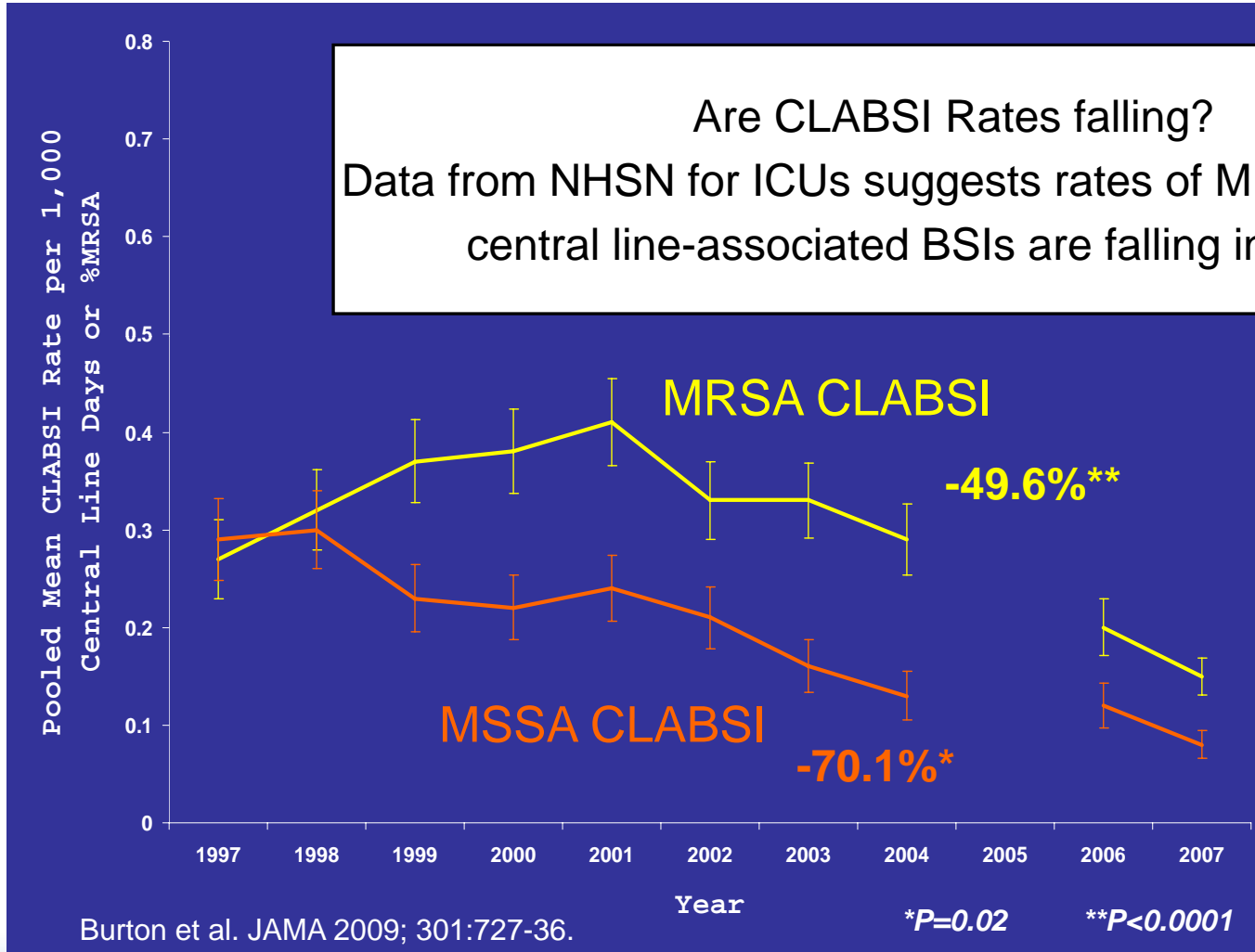


# Background: Epidemiology

## ALL ICU TYPES: Rates of Methicillin-Resistant and Methicillin-Sensitive *Staphylococcus aureus* CLABSIs— United States, 1997-2007



Are CLABSI Rates falling?  
Data from NHSN for ICUs suggests rates of MRSA and MSSA central line-associated BSIs are falling in the U.S.





# Background: Epidemiology Modifiable Risk Factors



Characteristic	Risk Factor Hierarchy
Insertion circumstances	Emergency > elective
Skill of inserter	General > specialized
Insertion site	Femoral > subclavian
Skin antisepsis	70% alcohol, 10% povidone iodine > 2% chlorhexidine
Catheter lumens	Multilumen > single lumen
Duration of catheter use	Longer duration of use greater risk
Barrier precautions	Submaximal > maximal



# Background: Prevention Strategies Interventions



- Pittsburgh Regional Health Initiative – Decrease in CLABSIs in 66 ICUs (68% decrease)
  - Interventions
    - Promotion of best practices
      - » Maximal barrier precautions
      - » Use of chlorhexidine for skin cleansing prior to insertion
      - » Avoidance of femoral site for CL
      - » Use of recommended insertion-site dressing practices
      - » Removal of CL when no longer needed
    - Educational module about BSI prevention
    - Standard tools for recording adherence to best practices
    - Standardizing catheter insertion kits
    - Measurement of CLABSI and reporting of rates back to facilities

CDC. MMWR 2005;54:1013-6.



# Background: Prevention Strategies Interventions



- Michigan Keystone Project
- Decrease in CLABSI in 103 ICUs in Michigan (66% reduction)
- Basic interventions:
  - Hand hygiene
  - Full barrier precautions during CL insertion
  - Skin cleansing with chlorhexidine
  - Avoiding femoral site
  - Removing unnecessary catheters
  - Use of insertion checklist

Pronovost et al. NEJM 2006;355:2725-32.



# Prevention Strategies

- **Core Strategies**

- High levels of scientific evidence
- Demonstrated feasibility

- **Supplemental Strategies**

- Some scientific evidence
- Variable levels of feasibility

\*The Collaborative should at a minimum include core prevention strategies. Supplemental prevention strategies also may be utilized. Hospitals should not be excluded from participation if they already have ongoing interventions using supplemental prevention strategies. Project coordinators should carefully track which prevention strategies are being utilized by participating facilities.



# Prevention Strategies: Core



- Removing unnecessary CL
- Following proper insertion practices
- Facilitating proper insertion practices
- Complying with hand hygiene recommendations
- Adequate skin antisepsis
- Choosing proper CL insertion sites
- Performing adequate hub/access port disinfection
- Providing education on CL maintenance and insertion



# Prevention Strategies: Core Removing Unnecessary CL



- In one study, 9% of CLs outside of ICU deemed inappropriate
- Perform daily assessment of the need for the CL and promptly discontinue CLs that are no longer required
- Nursing staff should be encouraged to notify physicians of CLs that are unnecessary
- Use peripheral catheters instead
  - These generally have lower rates of BSIs than CL

Trick et al. Infect Control Hospital Epidemiol 2004;25:266-8.





# Prevention Strategies: Core Proper Insertion Practices



- Ensure utilization of insertion bundle:
  - Chlorhexidine for skin antisepsis
  - Maximal sterile barrier precautions (e.g., mask, cap, gown, sterile gloves, and large sterile drape)
  - Hand hygiene
- Many CLs in patients on non-ICU hospital wards are placed outside those wards (Emergency room, ICU, Operating room, or Pre-operative areas)
- In one study, 49% of CLs were present on admission to the ward. Rates of BSI in this study were higher in CLs placed in Emergency Room
- Define where placement occurs and review technique in those areas

Trick et al. Am J Infect Control 2006;34:636-41.



## Prevention Strategies: Core



# Facilitating Proper Insertion Practices

- “Bundling” all needed supplies in one area (e.g., a cart or a kit) helps ensure items are available for use
- Use of a “checklist” to ensure all insertion practices are followed may be beneficial
- Empowering staff to stop a non-emergent CL insertion if proper procedures are not followed



## Prevention Strategies: Core Hand Hygiene



- Hand hygiene should be a cornerstone of CLABSI prevention efforts
  - For both insertion and maintenance
- As part of a hand hygiene intervention, consider:
  - Ensuring easy access to soap and water and alcohol-based hand gels
  - Education for HCP and patients
  - Observation of practices - particularly around high-risk procedures (before and after contact with CL)
  - Feedback – “Just in time” feedback if failure to perform hand hygiene observed



## Prevention Strategies: Core



# Chlorhexidine Skin Cleansing

- Chlorhexidine is the preferred agent for skin cleansing for both CL insertion and maintenance
  - Tincture of iodine, an iodophor, or 70% alcohol are alternatives
  - Recommended application methods and contact time should be followed for maximal effect
- Prior to use should ensure agent is compatible with catheter
  - Alcohol may interact with some polyurethane catheters
  - Some iodine-based compounds may interact with silicone catheters



## Prevention Strategies: Core CL Site Choice



- For adult patients receiving non-tunneled CL, femoral site should be avoided due to an increased risk of infection and deep venous thrombosis
- Note:
  - In patients with renal failure, subclavian site should be avoided to minimize stenosis which may limit future vascular access options



## Prevention Strategies: Core Hub/access port cleansing



- BSI “outbreaks” have been associated with failure to adequately decontaminate catheter hubs or failure to change them at appropriate intervals
- Efforts should be made to completely cleanse hubs prior to use with an appropriate antiseptic
- Manufacturer recommendations regarding cleansing and changing connectors should be followed



## Prevention Strategies: Core



# CL Maintenance and Insertion: Education

- Personnel responsible for insertion and maintenance of catheters should be trained and demonstrate competence
- Recurrent educational sessions for staff who care and/or insert CLs



# Prevention Strategies: Supplemental



- Supplemental strategies include:
  - Chlorhexidine bathing
  - Antimicrobial-impregnated catheters
  - Chlorhexidine-impregnated dressings





## Prevention Strategies: Supplemental Chlorhexidine Bathing



- In an ICU at a single center, daily bathing with 2% chlorhexidine-impregnated cloths decreased the rate of BSIs compared to soap and water
- No data outside the ICU

Bleasdale, et al. Arch Intern Med 2007;167:2073-9.



## Prevention Strategies: Supplemental Antimicrobial-Impregnated Catheters

- 2 types with most supporting evidence:
  - Minocycline-Rifampin
  - Chlorhexidine–Silver Sulfadiazine
- Platinum-Silver catheter available but less evidence to support use
- These may be appropriate for patients whose catheter is expected to be used for more than 5 days and when Core strategies have not decreased rates of CLABSI to established goals.



## Prevention Strategies: Supplemental Chlorhexidine Dressings



- Chlorhexidine-impregnated sponge dressings have been shown to decrease rates of CLABSIs in some studies and not in others.
- These dressings may be an option when Core interventions have not decreased rates of CLABSI to established goals



# Summary of Prevention Strategies



## Core Measures

- Removing unnecessary CL
- Following proper insertion practices
- Facilitating proper insertion practices
- Complying with hand hygiene recommendations
- Performing adequate skin cleaning
- Choosing proper CL insertion sites
- Performing adequate hub/access port cleaning
- Providing education on CL maintenance and insertion

## Supplemental Measures

- Implementing chlorhexidine bathing
- Using antimicrobial-impregnated catheters
- Applying chlorhexidine site dressings



# Measurement



- With CLABSI measurement it is important to
  - Have a definition that is consistent between sites
  - Collecting blood cultures in a similar fashion
    - For recommended indications
    - Via a peripheral venipuncture vs. via a CL



# Measurement: Process Measures



- Process measures can help determine if interventions are being fully implemented
  - Ensuring interventions are being performed is itself a “core” intervention
- Potentially important process measures to consider are:
  - Hand hygiene adherence
  - Proportion of patients with CLs, and/or duration of CL use
  - Proportion of CL insertions in which maximal barrier precautions were used
- Consider using NHSN Central Line Insertion Practices (CLIP) option



## Measurement: Outcome Calculating CLABSI Rates



$$\text{CLABSI Rate}^* = \frac{\text{\# CLABSIs identified}}{\text{\# central line-days}} \times 1000$$

\* Stratify by:

- Type of ICU/Other Location
- For special care areas
  - Catheter type (temporary or permanent)
- For neonatal intensive care units
  - Birthweight category
  - Catheter type (umbilical or central)



## Measurement: Outcome Device Utilization (DU) Ratio

$$\text{CL DU Ratio} = \frac{\# \text{ central line-days}}{\# \text{ patient-days}}$$

DU Ratio measures the proportion of total patient-days in which central lines were used.





# Measurement: Process CLIP Adherence Rates



- **Using NHSN, adherence rates can be calculated for:**
  - Hand hygiene
  - Barrier precautions used including masks, sterile drape, gowns and sterile gloves
  - Skin preparation including type of agent and whether agent was allowed to dry
- **Other measures collected in the NHSN CLIP option that can be summarized include:**
  - CL type, location, and number of lumens
  - Antiseptic ointment applied to site



# Measurement: Process

## Calculating CLIP Adherence Rates

$$\text{Hand Hygiene Adherence Rate} = \frac{\text{\# hand hygiene performed for CL insertion}}{\text{\# CL insertions records completed}}$$

Adherence rates can also be measured for each of the barrier and prevention practices by using the number of CLIP records completed as the denominator.



# Tools for Implementation

## NHSN CLIP Option: Insertion Practices



### Event Information [HELP](#)

Event Type\*:

Location\*:

Date of Insertion\*:

Person recording insertion practice data>:  Inserter  Observer

Central Line Inserter ID:

Last Name:  First Name:

Occupation of inserter>:

### Insertion Details [HELP](#)

Reason for insertion>:

Inserter performed hand hygiene prior to central line insertion>:

Maximal sterile barrier precautions used>:

- Mask
- Sterile gown
- Large sterile drape
- Sterile gloves
- Cap

Skin Preparation (check all that apply)>:  Chlorohexidine gluconate  Povidone iodine  Alcohol  Other

Was skin preparation agent completely dry at the time of first skin puncture?>:

Insertion site>:

Antimicrobial coated catheter used:

Central line catheter type>:

Number of lumens>:

Central line exchanged over a guidewire>:

Antiseptic ointment applied to site>:



# Evaluation Considerations



- **Assess baseline policies and procedures**
- **Areas to consider**
  - **Surveillance**
  - **Prevention strategies**
  - **Measurement**
- **Coordinator should track new policies/practices implemented during collaboration**

**Standardized questions forthcoming**



# References

- Bleasdale SC, Trick WE, Gonzalez IM, et al. Effectiveness of chlorhexidine bathing to reduce catheter-associated bloodstream infections in medical intensive care unit patients. *Arch Intern Med* 2007; 67:2073-9.
- Burton DC, Edwards JR, Horan TC, et al. Methicillin-resistant *Staphylococcus aureus* central line-associated bloodstream infections in US intensive care units, 1997-2007. *JAMA* 2009;301:727-36.
- CDC. Reduction in central line-associated bloodstream infections among patients in intensive care units—Pennsylvania, April 2001-March 2005. *MMWR* 2005;54:1013-6.



# References



- Climo M, Diekema D, Warren DK, et al. Prevalence of the use of central venous access devices within and outside of the intensive care unit: results of a survey among hospitals in the prevention epicenter program of the Centers for Disease Control and Prevention. *ICHE* 2003;24:942-5.
- Edwards, JR, Peterson KD, Mu Y, et al. National Healthcare Safety Network (NHSN) report: Data summary for 2006 through 2008, issued December 2009. *Am J Infect Control* 2009;37:783-805.



- Klevens RM, Edwards JR, Richards CI, et al. Estimating health care-associated infections and deaths in U.S. hospitals, 2002. Public Health Reports 2007;122:160-6.
- Pittet D, Tarara D, Wenzel RP. Nosocomial bloodstream infection in critically ill patients. Excess length of stay extra costs, and attributable mortality. JAMA 1994;271:1598-1601.



# References



- Marschall J, Leone C, Jones M, et al. Catheter-associated bloodstream infections in general medical patients outside the intensive care unit : a surveillance study. *ICHE* 2007; 28:905-9.
- Pronovost P, Needham D, Berenholtz S, et al. An intervention to decrease catheter-related bloodstream infections in the ICU. *NEJM* 2006;355:2725-32.
- Trick WE, Vernon MO, Welbel SF, et al. Unnecessary use of central venous catheters: the need to look outside the intensive care unit. *Infect Control Hospital Epidemiol* 2004; 25:266-8.





# References



- Trick WE, Miranda J, Evans AT, et al. Prospective cohort study of central venous catheters among internal medicine ward patients. *Am J Infect Control* 2006;34:636-41.